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(54) **POWER ALLOCATION IN PRINTING DEVICES**

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CPC ***B41J 11/002*** (2013.01); ***B41F 23/04*** (2013.01)

(58) **Field of Classification Search**

CPC B41F 23/04; B41F 33/00; B41J 11/002
See application file for complete search history.

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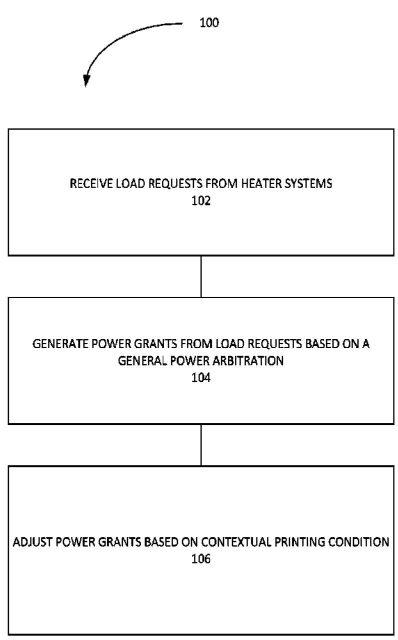
(57) **ABSTRACT**

Power allocation in printing devices is disclosed. Independent load requests are received from printing device heater systems. Power grants are allocated based on a general power arbitration of a power source in response to the independent load requests. A power grant is adjusted based on a contextual printing condition to provide an adjusted grant from the power source to a printing device heater system of the printing device heater systems.

15 Claims, 5 Drawing Sheets



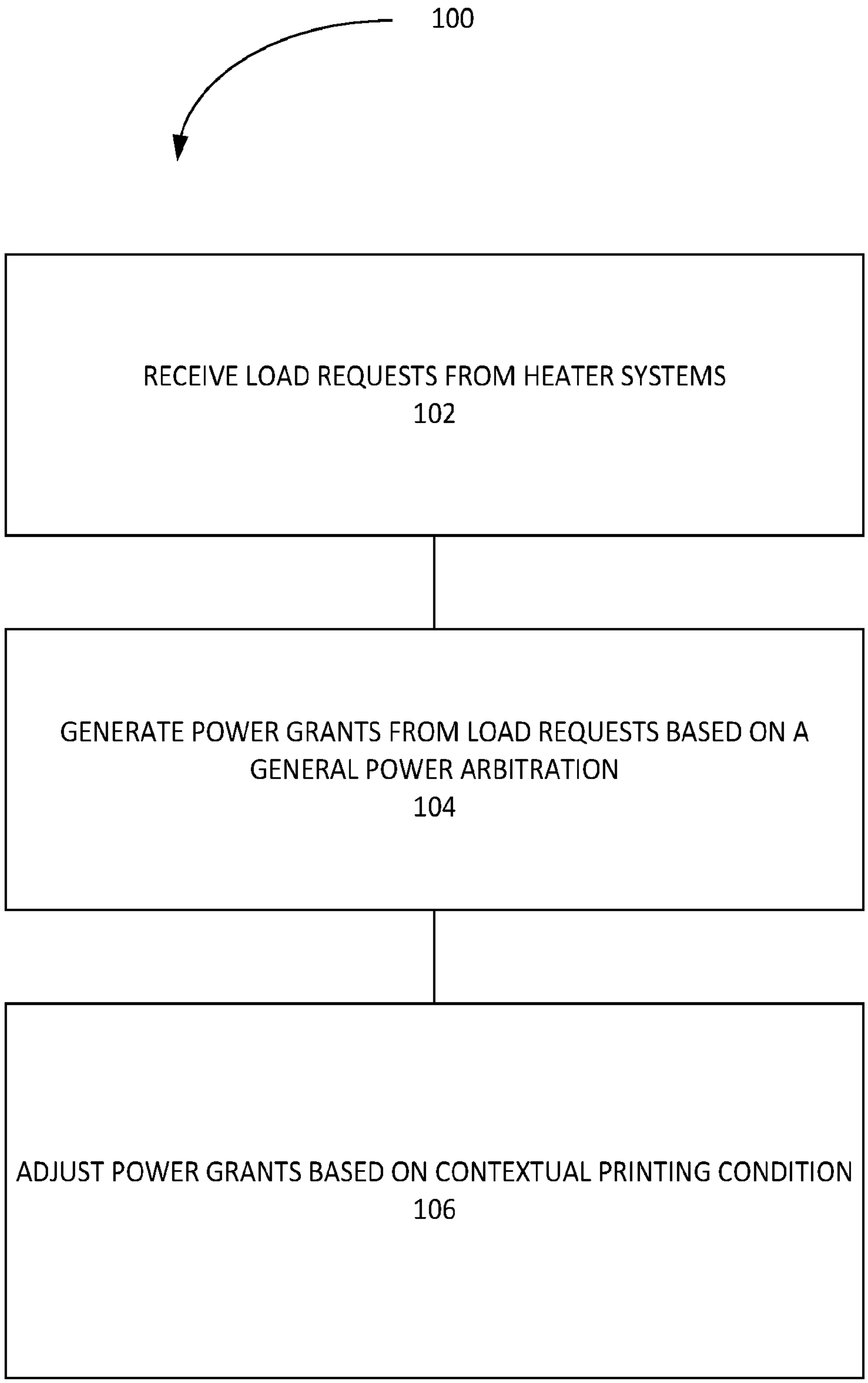

100
RECEIVE LOAD REQUESTS FROM HEATER SYSTEMS
102
GENERATE POWER GRANTS FROM LOAD REQUESTS BASED ON A GENERAL POWER ARBITRATION
104
ADJUST POWER GRANTS BASED ON CONTEXTUAL PRINTING CONDITION
106

FIGURE 1

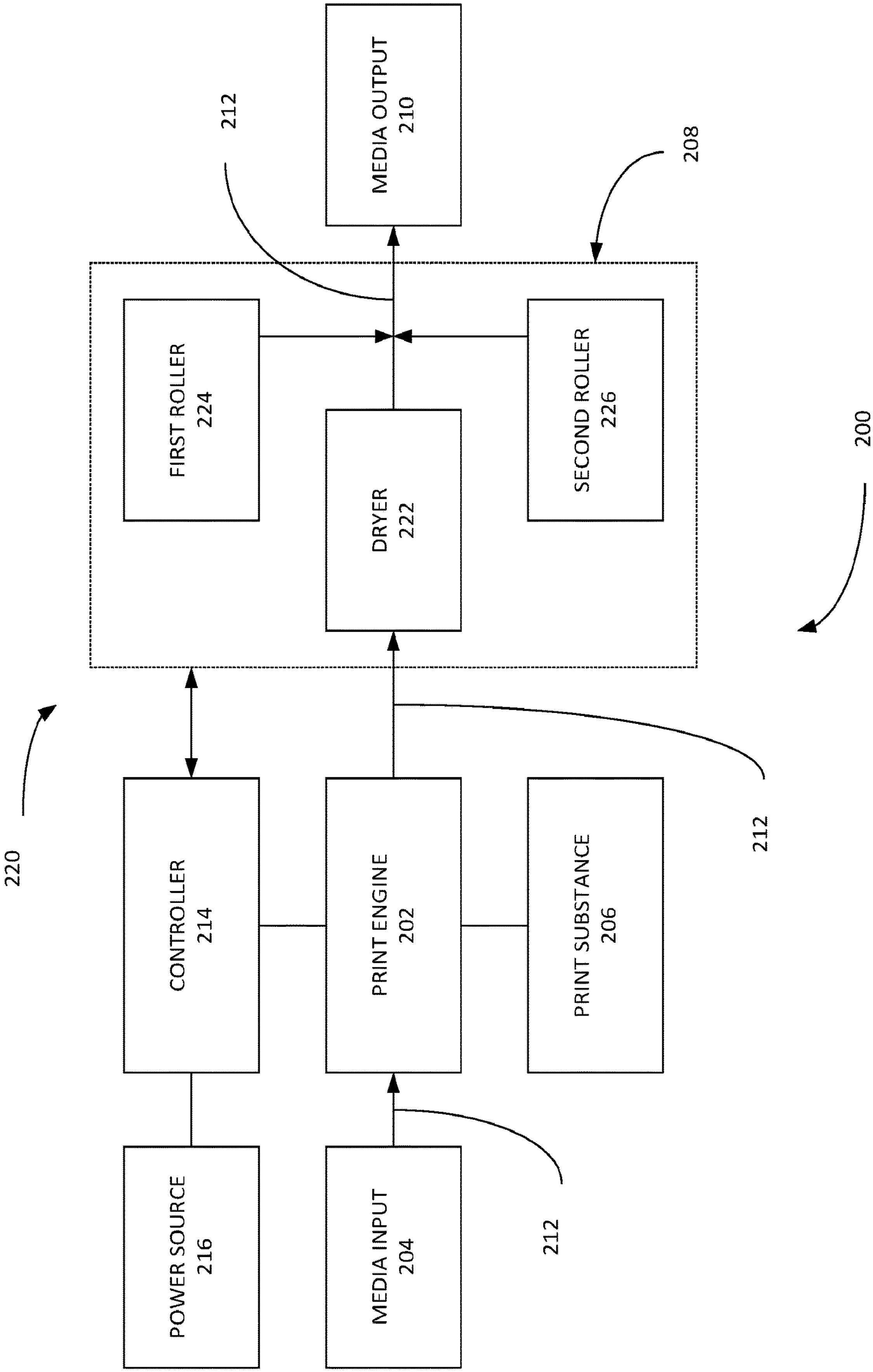

MEDIA OUTPUT
210
212
208
FIRST ROLLER
224
DRYER
222
SECOND ROLLER
226
200
220
CONTROLLER
214
PRINT ENGINE
202
PRINT SUBSTANCE
206
212
POWER SOURCE
216
MEDIA INPUT
204
212

FIGURE 2

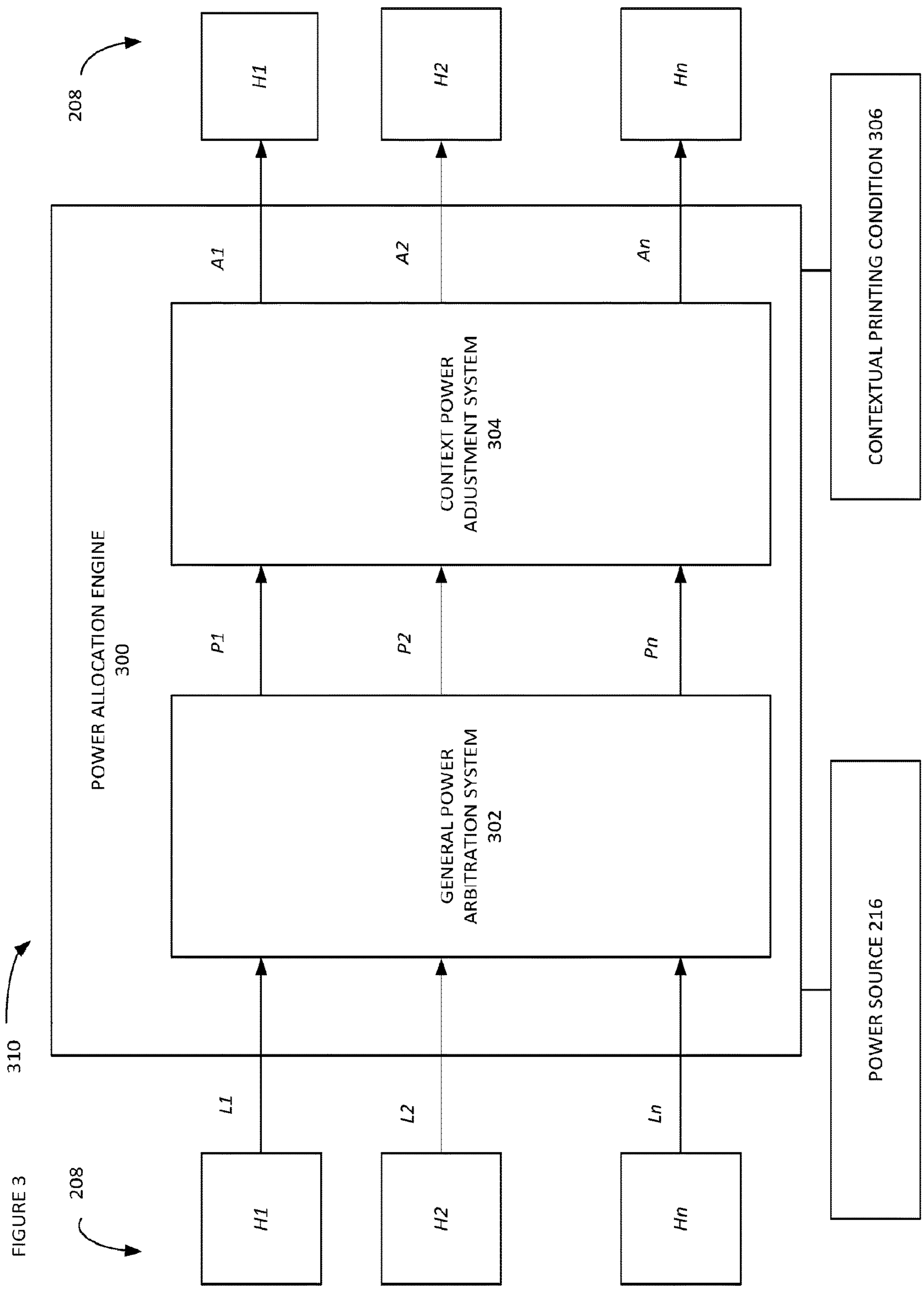

208
H1
H2
Hn
L1
L2
Ln
310
POWER ALLOCATION ENGINE
300
GENERAL POWER
ARBITRATION SYSTEM
302
P1
P2
Pn
CONTEXT POWER
ADJUSTMENT SYSTEM
304
A1
A2
An
208
H1
H2
Hn
POWER SOURCE 216
CONTEXTUAL PRINTING CONDITION 306

FIGURE 3

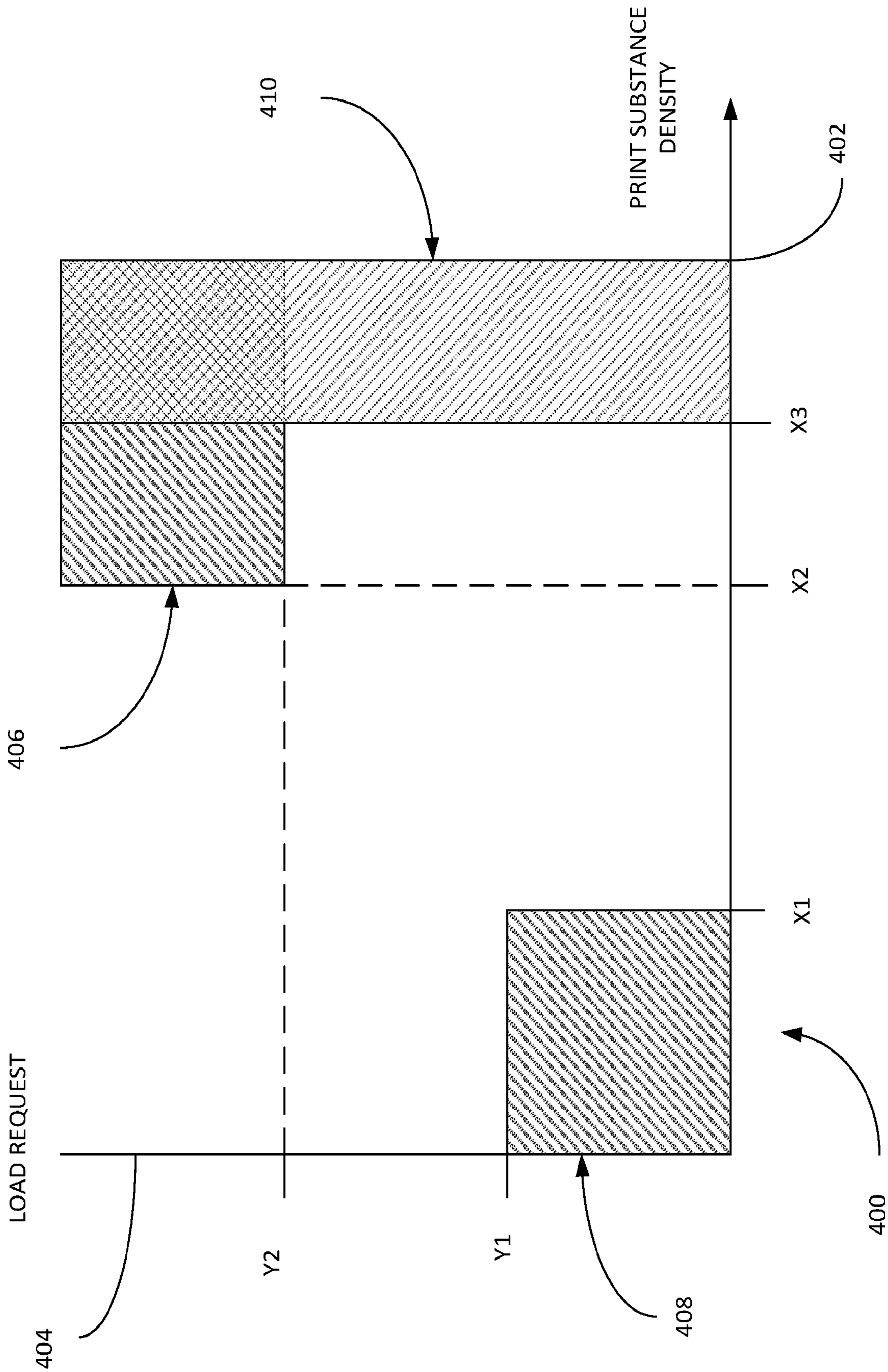

PRINT SUBSTANCE DENSITY
LOAD REQUEST
400
402
404
406
408
410
X1
X2
X3
Y1
Y2

FIGURE 4

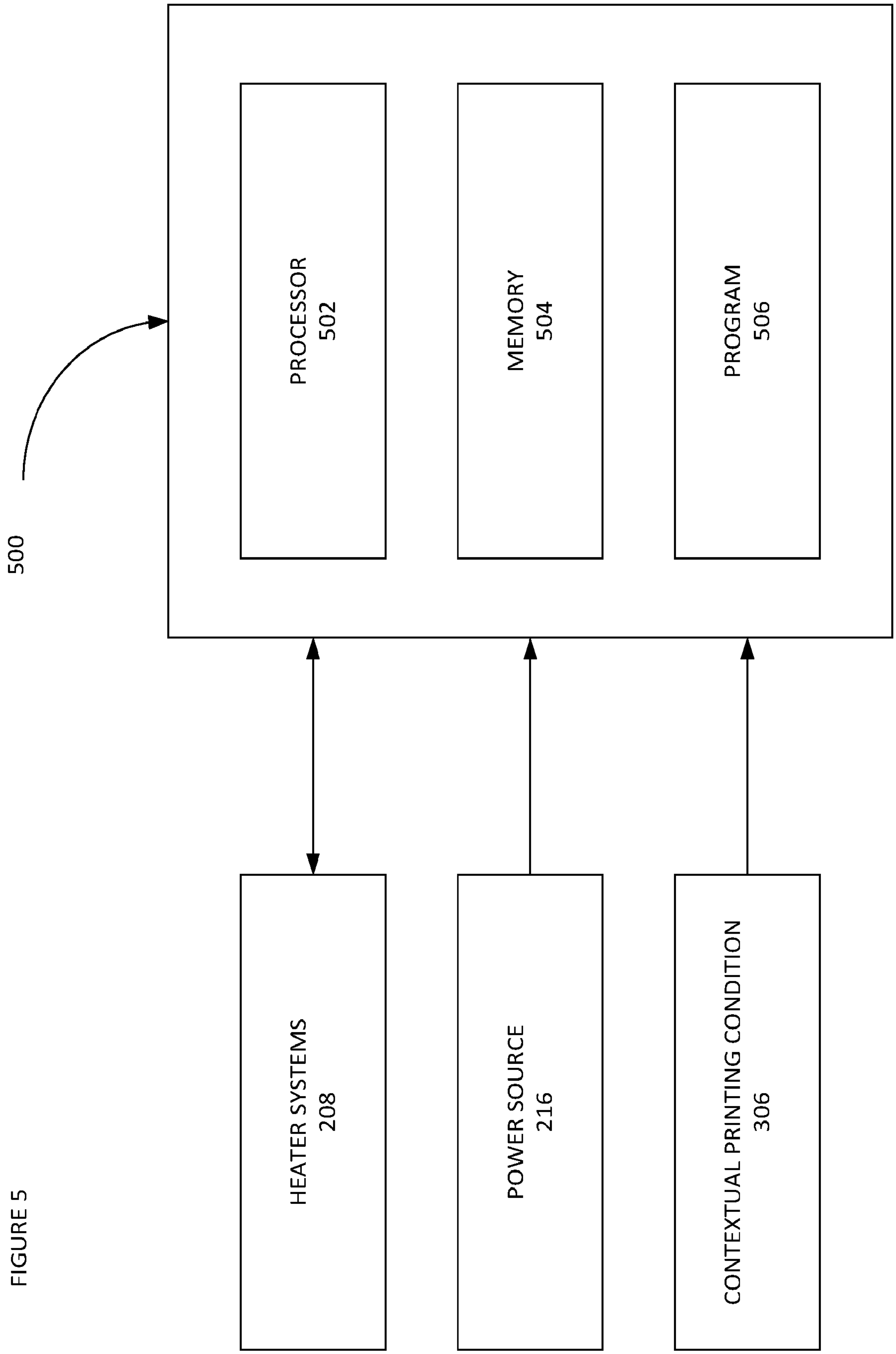

500
PROCESSOR
502
MEMORY
504
PROGRAM
506
HEATER SYSTEMS
208
POWER SOURCE
216
CONTEXTUAL PRINTING CONDITION
306

FIGURE 5

POWER ALLOCATION IN PRINTING DEVICES

BACKGROUND

Printing devices can include printers, copiers, fax machines, multifunction devices including additional scanning, copying, and finishing functions, all-in-one devices, or other devices such as pad printers to print images on three dimensional objects and three-dimensional printers such as additive manufacturing devices. In general, printing devices apply a print substance often in a subtractive color space or black to a medium via a device component generally referred to as print engine having a print head. A medium can include various types of print media, such as plain paper, photo paper, polymeric substrates and can include any suitable object or materials to which a print substance from a printing device is applied including materials, such as powdered build materials, for forming three-dimensional articles. Print substances, such as printing agents, marking agents, and colorants, can include toner, liquid inks, or other suitable marking material that in some examples may be mixed with fusing agents, detailing agents, or other materials and can be applied to the medium.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an example method.

FIG. **2** is a block diagram illustrating an example printing device to implement the example method of FIG. **1**.

FIG. **3** is a block diagram illustrating an example system to implement the example method of FIG. **1**, which can be included in the example printing device of FIG. **2**.

FIG. **4** is a chart illustrating a plurality of contextual printing conditions applicable to the example system of FIG. **3**.

FIG. **5** is a block diagram illustrating an example system to implement the example method of FIG. **1**, which can be included in the example printing device of FIG. **2**.

DETAILED DESCRIPTION

Printing devices may include conditioning systems, which can apply heat or pressure to a printed medium prior to output. In one example, a medium may progress through a printing device along a media path from a print engine, which can apply a print substance to the medium, to the conditioning system, which can apply heat or pressure to the printed medium, and then to an output. In some examples, the output of a printing device can be coupled to a finishing system that can include stapling systems and collation stackers. The print engine may be configured for image quality that can produce undesirable physical characteristics in the medium that may affect the final product or make difficult further processing of the output media. For instance, as a medium such as piece of paper becomes more saturated with a print substance, the paper becomes less stiff and begins to suffer from cockle, which includes wrinkling in areas of print substance, or begins to curl or bend. The undesirable physical characteristics can also lead to difficulty, unreliability, or failure of finishing devices coupled to the printing device. Accordingly, conditioning systems can be included to improve the physical characteristics and quality of the printed medium within a sufficient amount of time of output to meet user expectations.

Conditioning systems impose additional power loads on the printing device in order to create sufficient heat to

improve the quality of the printed medium. Many conditioning systems include a plurality of heater systems that can be selected from different types of heater systems such as dryers, fusers, and heated pressure rollers. A selected amount of power from a printing device power source, such as an alternating current type electrical power from a printing device power supply, is allocated to the plurality of heater systems as well as to the other systems of the printing device. Printing devices can include power allocation engines as an aspect of the controller to allocate or arbitrate the available amount of power to the printing device between the conditioning system and other systems of the printing device. Further, the conditioning system may include a power allocation engine as an aspect of the controller to allocate or arbitrate the available amount of power to the conditioning system between the plurality of heater systems. Under some circumstances, the demand for power may exceed the available amount of power from the power source or the amount of power to the conditioning system in which case the power allocation engines can make compromises between the heater systems. If not properly managed, the compromises can create undesirable performance issues such as poor output quality or long job completion times that can result in poor stack quality, media transport failures, poor device reliability, and printing delays.

In one example, a printing device conditioning system includes a plurality of heater systems. Each heater system of the plurality of heater systems can include an autonomous servomechanism that operates independently of the other heater systems of the plurality of heater systems. Each heater system includes a temperature sensor and a corresponding temperature setpoint. Based on the operational error between a measured temperature and the setpoint, the heater system makes a load request for an amount of power. Each load request from the plurality of heater systems is independent of the other load requests of the plurality of heater systems. The independent load requests are provided to a power allocation engine. In general, the power allocation engine applies a power arbitration process to the plurality of independent load requests. The power allocation engine allocates the available amount of power to the conditioning system based on the power arbitration process and allocates a power grant to each of the plurality of heater systems.

The power arbitration process of a typical power allocation engine is generally simple to implement and delivers a predictable output tuned to provide a plurality of power grants to common load request profiles or scenarios. One type of power arbitration process may allocate power grants according to fixed weights assigned to the heater systems providing the load requests. Another type of power arbitration process may allocate power grants according to a fixed priority order of the heater systems providing the load requests. The power arbitration process may consider such factors as the position of the heater system along the media path or a thermal time constant of the heater system. In such power arbitration processes, higher priority heater systems or heater systems assigned greater weights in the process may receive more power per amount of load request or heat more quickly than lower priority heater systems or heater systems assigned lower weights in the process. While such power arbitration processes are suited for common load request profiles or scenarios, such power arbitration processes may experience slower response or imprecise thermal control under less common contexts. In some examples, a conditioning system may be subjected to numerous different contexts that could benefit from more specific power arbitration processes that could improve job throughput times and output quality.

The disclosure describes a printing device having a conditioning system with a power allocation engine including a context power adjustment system. The context power adjustment system allows the power allocation engine to adapt to many of the less common power request profiles or to more precisely tune the conditioning system to different printing contexts, including common printing contexts. In one example, heater systems can apply servomechanism processes to request power from the power allocation engine in the form of independent load requests. The power allocation engine can include a general power arbitration system to generate a corresponding power grant in response to the load request based on an available amount of power from a power source. The power grants are provided to the context power adjustment system to adjust, such as modify, the power grant based on a contextual printing condition. The power allocation engine can provide an adjusted power grant to each of the heater systems. In one example, the contextual printing context adjusts the power grants based on how the heater systems respond to various printing conditions. In some examples, the context power adjustment system may be configured to implement a number of different contextual printing conditions and provide increased response times or enhanced print quality for each context. As new load request profiles or contextual printing conditions are discovered or implemented and addressed with the context power adjustment system, existing configurations of contextual printing conditions can remain unaffected.

FIG. **1** illustrates an example method **100** for use with a printing device. For example, the example method **100** can be implemented with a power allocation engine for a conditioning system of a printing device. The conditioning system can include a plurality of printing device heater systems. The power allocation engine can distribute a power output from a power source to the plurality of printing device heater systems.

A plurality of independent load requests from each of a plurality of printing device heater systems is received at **102**. The independent load requests can be received at the power allocation engine. Each heater system of the plurality of printing device heater systems provides a corresponding independent load request to the power allocation engine. In one example of negative feedback heater systems, each of the load requests can be based on an autonomous determination of the corresponding heater system of an amount of power appropriate for the corresponding heater system to address the operational error between a setpoint and the measured process variable such as temperature from a temperature sensor. In some examples, a sum total of the plurality of independent load requests may exceed the power output from a power source, such as an amount of power allocated to the conditioning system.

Based on a general power arbitration of the power output from the power source, a plurality of power grants are allocated in response to the plurality of independent load requests at **104**. The power allocation engine can allocate a power grant to each heater system based on the load request of the heater system. In one example, the general power arbitration ensures that a sum total of the plurality of power grants does not exceed the power output from the power source such as the amount of power allocated to the conditioning system. In one example, the general power arbitration may allocate the plurality of the power grants according to fixed weights assigned to the heater systems based on the received plurality of independent load requests. In this example, the weights may be assigned to the plurality of heater systems in such a manner as to give a load request from a heater system of the plurality of heater systems preference over a load request from another heater system of the plurality of heater systems, or the weights may be assigned to the plurality of heater systems in such a manner as to not give preference to the load request of a heater system over the load request of another heater system. In another example, the general power arbitration may allocate the plurality of the power grants according to a fixed priority order of heater systems. In this example, the general power arbitration provides a power grant to a load request from a heater system having a higher assigned priority before it will provide a power grant to a load request from a heater system having a lower assigned priority.

A power grant of the plurality of power grants is adjusted based on contextual printing condition to provide an adjusted grant to a printing device heater system of the plurality of printing device heater systems at **106**. According to the contextual printing condition, the power grant corresponding with a load request from a heater system is adjusted to create an adjusted grant, and the adjusted grant is provided to the heater system. In one example, each of the plurality of the power grants are adjusted to provide a plurality of adjusted grants based on the contextual printing condition, and the plurality of adjusted grants are provided to the heater systems. The sum total of the plurality of adjusted grants and any (unadjusted) power grants does not exceed the power output from the power source such as the amount of power allocated to the conditioning system.

Power allocation engine can receive load requests, allocate power grants, and provide adjusted grants in quantities that can be expressed with respect to the terms of power output from the power source. In one example, the quantities can be expressed as a percentage of power output. In another example, the quantities can be expressed as units of the power source. For instance, the load requests, power grants, adjusted grants, and power output can be received, allocated, or provided as a pulse width modulation signal, or PWM signal. The power allocation engine can receive load requests, allocate power grants, and provide adjusted grants of power in terms of PWM. In general, a conditioning system may receive a power output S from a power source and include n heater systems in the plurality of heater systems such as heater systems $H_1, \ldots, H_n$. A heater system of the plurality of heating systems may be represented as heater system H_i in which i is an integer from 1 to n. The power allocation engine can receive a load request L_i from heater system H_i, and load request L_i corresponds with heater system H_i. Based on a general power arbitration of the power output from the power source, a power grant P_i of the plurality of power grants is allocated in response to the load request L_i of the plurality of independent load requests, and power grant P_i corresponds with load request L_i. The power grant P_i of the plurality of power grants is adjusted based on contextual printing condition to provide an adjusted grant A_i to a printing device heater system H_i of the plurality of printing device heater systems, and heater system H_i corresponds with adjusted grant A_i, which corresponds with power grant P_i.

The contextual printing condition can be based on various conditioning characteristics or characteristics of the printing device that may affect printing under general power arbitration. For example, the contextual printing condition may be based on factors such as print substance density, or an amount of print substance to be applied to a unit of media for a given printing project or printed medium. Print substance density can affect power used to condition the printed media, and a printed medium having a higher print substance density may employ more power to condition the media than a printed medium having a relatively lower print substance density. In another example, the contextual printing condition may be affected by ambient settings such as ambient temperature, ambient humidity, and atmospheric pressures. In still another example, the contextual printing condition may be based on printing characteristics such as orientation of the medium, such as page orientation, and whether or how a printed medium will interface with a heater system. In still another example, the contextual printing condition may be based on the temperatures of the heater systems either independently or with respect to each other. For instance, a contextual printing condition may be created at startup or upon awakening from a sleep or standby mode at which time the heater systems may be at ambient temperature or near ambient temperature and the power allocation engine seeks to quickly prepare the printing device for printing a project having a given print substance density or a given orientation of the medium. Still other examples are contemplated and a few examples are illustrated in this disclosure.

The example method **100** can be implemented to include hardware devices, programs, or hardware devices and programs for controlling a system having a processor and memory, that can distribute a power output from a power source to a plurality of printing device heater systems. For example, method **100** can be implemented as a set of executable instructions stored in a computer memory device for controlling the processor.

In one example contextual printing condition, the adjusted grant is selected from one of the power grant and a power grant limit if the power grant exceeds the power grant limit. In one example, each of the plurality of the power grants are adjusted to provide a plurality of adjusted grants based on the contextual printing condition, and the plurality of adjusted grants are provided to the heater systems. In this example, each adjusted grant of the plurality of adjusted grants is selected from one of the corresponding power grant and a corresponding power grant limit if the power grant exceeds the power grant limit for the corresponding heater system. In one example, the amount of power that can be provided to the each of the heater systems is capped regardless of the determination of the general power arbitration. The sum total of the plurality of adjusted grants and any (unadjusted) power grants does not exceed the power output from the power source such as the amount of power allocated to the conditioning system. In one example, the sum total of the power grant limits for each heating system does not exceed the power output of the power source. For example, an adjusted grant A, selected from one of the power grant P_i and a power grant limit Cap_i if the power grant P_i exceeds the power grant limit Cap_i. For instance, $A_i=\min(P_i, Cap_i)$ in which $\min(P_i, Cap_i)$ returns the lesser value of P_i and Cap_i. In one example, $(Cap_1+, \ldots, Cap_n)$ does not exceed S, or $(Cap_1+, \ldots, +Cap_n)=S$.

The contextual printing condition can be invoked at system startup or awakening from system sleep or standby mode in which the heater systems may be at ambient temperature and may each provide relatively high load requests. Power to the heater systems can be distributed in an evenhanded manner rather than permit a heater system to starve another heater system of power under general power arbitration.

In another contextual printing condition, a power grant of the plurality of power grants is adjusted based on a contextual printing condition of a selected orientation of the medium to provide an adjusted grant to a printing device heater system of the plurality of printing device heater systems. General power arbitration may be based on the most common orientation of the medium. The selected orientation of the medium may be subjected to different heater systems or a different number of the plurality of heater systems than the most common orientation. For example, a most common orientation may include a longer edge of a page as the leading edge, and the selected orientation may include a shorter edge of the page as the leading edge. In a conditioning system that includes an inner heater system and an outer heater system, such as an inner heated pressure roller system and an outer heated pressure roller system, the medium may not be subjected to much heat from the outer heated pressure roller system in the selected orientation. In such an example, the power grant to the outer heated pressure roller system may be apportioned to the inner heated pressure roller system or to other heater systems of the plurality of printing device heater systems in the adjusted grant.

In one example, a first heater system H_1 can be an inner heater system, such as an inner heated pressure roller system, and a second heater system H_2 can be an outer heater system, such as an outer heated pressure roller system. In the example, the printed medium in the selected orientation is affected more from the inner heater system, i.e., H_1, than the outer heater system, i.e., H_2. The inner heater system H_1 is provided with an adjusted grant A_1 at **106** that includes a factor or an amount greater than the power grant P_1 based on the load request L_1 at **104**. The factor or the amount is apportioned from the second power grant P_2.

For example, if a printing device is configured to provide a printed medium in a selected page orientation having an inner heater system H_1 and an outer heater system H_2, then

$A_1=j^{-1}P_1$, in which j is greater than 0 and less than or equal to 1;

$A_2=P_2-(j^{-1}P_1-P_1)$.

In another example, if a printing device is configured to provide a printed medium in a selected page orientation having an inner heater system H_1 and an outer heater system H_2, then

$A_1=P_1+j*M$, in which j is greater than 0 and less than or equal to 1;

$A_2=P_2-M$, in which M is an offset amount.

In a contextual printing condition based on print substance density, substantially all of the power output S is allocated to the printing device heater system H_i of the plurality of printing device heater systems if the print substance density exceeds a selected print substance density threshold and the load request L_i of the plurality of independent load requests is outside a selected load threshold. In one example, heater system H_1 is provided with a power grant of S while the remaining heater system H_2 or remaining systems $H_2, \ldots, H_n$ of the plurality of heater systems receive a power grant of no power.

The contextual printing condition may be applied to situations in which a relatively large amount of print substance is applied to a medium and the printing device has been idle such that the heater systems are at or near ambient temperature or include a substantial operational error between the setpoint and the process variable. In such a contextual printing condition, a greater share of the power output, such as all or substantially all of the power output, may be allocated to a heater system with a relatively high thermal time constant, such as an evaporative dryer system, rather than allocate power to heater systems with relatively low thermal time constants such as heated pressure roller systems. In this contextual printing condition, the dryer system will receive the power until sufficiently heated before the power is provided to the heated pressure roller systems or other heater systems with relatively low thermal time constants. The load request threshold can be selected to permit relatively fast heating of the plurality of heater systems as compared to a general power arbitration.

In another contextual printing based on print substance density, a first power grant P_1 and second power grant P_2 are adjusted to obtain first adjusted grant A_1 and second adjusted grant A_2 such that a measure M of the first power grant P_1 is apportioned to the second power grant P_2 rather than the measure M provided to the first power grant P_1 if a print substance density does not exceed a selected print substance density threshold and the first load request does not exceed a selected load request threshold.

For example, if a print substance density does not exceed a selected print substance density threshold and the first load request does not exceed a selected load request threshold, then

$A_1=P_1-M$

$A_2=P_2+j*M$, in which j is greater than 0 and less than or equal to 1.

The contextual printing condition may be applied to situations in which a relatively small amount of print substance is applied to a medium and the first heater system H_1, with the larger thermal time constant than the thermal time constant of heater system H_2, provides a relatively small load request L_1. In such a situation, the printing device can begin printing with a relatively low temperature of the first heater system H_1 or without having to allocate much or any of the power output S to the first heater system H_1. Instead, the second heater system H_2 is given priority in the power allocation because such heater systems have primacy in circumstances of print outputs of low print substance density and in receiving a relatively small load request L_1 from the first heater system H_1 with the higher thermal time constant. In one example, the first heater system H_1 can be an evaporative dryer system with a relatively high thermal time constant and the second heating system H_2 or remaining systems $H_2, \ldots, H_n$, can be heated pressure roller systems with relatively low thermal time constants.

In another contextual printing based on print substance density, a first power grant P_1 and a second power grant P_2 are adjusted to obtain a first adjusted grant A_1 and a second adjusted grant A_2 such that a measure M of the second power grant P_2 is apportioned to the first power grant P_1 rather than the measure M provided to the second power grant P_2 if a print substance density exceeds a selected print substance density threshold.

For example, if a print substance density exceeds a selected print substance density threshold, then

$A_1=P_1+M$

$A_2=P_2-j*M$, in which j is greater than 0 and less than or equal to 1 and the sum of $A_1+, \ldots, +A_n$ is less than or equal to the power output S.

In another example, if a print substance density exceeds a selected print substance density threshold, then

$A_1=c*P_1$, in which c is an evaporative cooling factor greater than 1;

$A_2=P_2-(c*P_1-P_1)$.

The contextual printing condition may be applied to situations in which a relatively large amount of print substance is applied to a medium. In such a situation, the relatively large amount of print substance on the printed medium, particularly with a water-based print substance, may serve to cool a heater system with a relatively large thermal time constant during warming such as an evaporative dryer system. In this situation, the first heater system H_1 is provided with an adjusted grant A_1 that includes a measure greater than the power grant P_1 based on the load request L_1 to compensate for the cooling effect of the relatively large amount of print substance. The measure is apportioned from the second power grant P_2 or the other power grants $P_2, \ldots, P_n$, such that the second heater system H_2 or the other heater systems $H_2, \ldots, H_n$ are provided with an adjusted grant $A_2, \ldots, A_n$ that is less than the power grants $P_2, \ldots, P_n$ based on the corresponding load requests $L_2, \ldots, L_n$. In one example, the first heater system H_1 can be an evaporative dryer system with a relatively high thermal time constant during warming and the second heating system H_2 or remaining systems $H_2, \ldots, H_n$, can be heated pressure roller systems with relatively low thermal time constants.

In one example of a conditioning system including three heater systems H_1, H_2, H_3 in which H_1 is an evaporative dryer with a relatively high thermal time constant during warming and heater systems H_2, H_3 are heated pressure rollers with relatively low thermal time constants, if a print substance density exceeds a selected print substance density threshold, then

$A_1=P_1+M$;

$A_2=P_2-j*M$, in which j is greater than 0 and less than or equal to 1;

$A_3=P_2-k*M$, in which k is equal to 1-j.

FIG. **2** illustrates an example printing device **200** that can receive source images or models, implement example method **100** with a conditioning system **220**, and produce printed images or articles on or with media via a print process. Printing device **200** includes a print engine **202** that includes mechanisms and logic to print or mark images on media or form articles from media. A media input **204** can provide a selected medium to the print engine **202** on which the images can be printed or marked. The print engine **202** is coupled to a consumable print substance **206**, which can be used to print or mark the medium. For example, the printing device **200** can implement a subtractive color space and the print substance **206** includes each of a cyan, magenta, yellow, and black print substance or the printing device **200** can implement a greyscale color space and the print substance includes a black print substance. Examples of print engines **202** can include ink jet print engines that apply a fluid, such as a liquid print substance **206** including water-based print substances, and laser print engines that apply particles of a toner as the print substance **206**. In one example, the print engine **202** delivers the print substance **206** to the medium via a print head selectively positioned proximate the medium. Printed media from the print engine **202** can be provided to a plurality of heater systems **208**, which can apply heat to the printed media, and subsequently to a media output **210**. In one example, the media output **210** can include or be coupled to a finishing module that can cut, collate, stack, staple, or otherwise provide the printed media in a selected finished form. In one example, the medium is provided along a media path **212** in the printing device **200** from the media input **204** to the media output **210**. For example the media path **212** can be arranged to extend from the media input **204**, to the print engine **202**, through the plurality of heater systems **208**, which may be selectively arranged along the media path **212**, to the media output **210**.

A controller **214**, which can include a combination of hardware and programming, such as firmware stored on a memory device executed with a processing device, is operably coupled to the print engine **202** and the plurality of heater systems **208** to perform methods that affect the print process and route the medium along the media path **212**. The controller **214** can be implemented in a variety of hardware configurations including a single processing node, a processing device having multiple processing nodes such as processing cores, and a set of interconnected processing devices having distributed processing nodes throughout the printing device **200**. The controller **214** can receive a signal representative of a digital image or model to be translated into a form suitable for the print engine **202** to apply the print substance **206** via the print head to a selected medium. In another example, the controller **214** is operably coupled to process sensors or process inputs to receive a signal representative of a process characteristic. Examples of process sensors can include ambient temperature sensors, humidity sensors, and atmospheric pressure sensors, and examples of process characteristic inputs can include speed of the printing process, the presence of finishing or conditioning equipment, simplex or duplex printing, and amount of sheets of media to be stapled. Also, the controller **214** can be operably coupled to the plurality of heater systems **208** to selectively operate and control the heater systems **208** as part of the print process. Still further, the printing device **200** can include a power source **216**, such as a power supply, to provide power to components of the printing device **200** such as the print engine **202**, the plurality of heater systems **208**, and the controller **214**, and the controller **214** can be used to selectively distribute power from the power source **216** based on a power allocation scheme such as method **100**.

The plurality of heater systems **208** can include dryers, blowers, fusers, heated pressure rollers, lamps, and other types of heating devices or elements that may be used to dry the print substance on the medium or otherwise condition the printed medium. The heater systems **208** can be arranged along the media path **212** to sequentially condition the printed medium, concurrently condition the printed medium such as two or more of the plurality of heater system **208** applied to the printed medium at the same time or at the same point in the media path **212**, or a combination of sequentially and concurrently arranged heater systems **208** along the media path **212**. In the example printing device **200**, the heater systems **208** include a dryer system **222**, a first heated pressure roller system **224**, and a second heated pressure roller system **226** for illustration. In the example, the dryer system **222** conditions the printed media along the media path **212** prior to the first and second heated pressure roller systems **224**, **226**. Also in the example, the first and second heated pressure roller systems **224**, **226** concurrently condition the printed medium along the media path **212**. The first heated pressure roller system **224** can include an inner heated pressure roller that may be configured to condition an inner section of a width of the media path **212**, and the second heated pressure roller system **226** can include an outer heated pressure roller that may be configured to condition an outer section, or outer sections of the width of the media path **212**. The first heated pressure roller system **224** can include a heating element such as a halogen lamp to heat the inner roller. The second heated pressure roller system **226** can also include a heating element such as a halogen lamp to heat the outer roller.

Heater systems **208** can be characterized by a thermal time constant that may be affected by factors such as thermal mass or the amount of power used to generate a selected temperature increase. For example, a heater system with a relatively high thermal time constant may include a relatively higher thermal mass, a relatively lower power applied to it to generate a selected temperature increase, or both compared to a heater system with a relatively low thermal time constant. In the example printing device **200**, the dryer system **222** includes a relatively higher thermal time constant than the time constants of the first and second heated roller systems **224**, **226**. The dryer system **222** can command a higher load request and an additional time to heat to a selected temperature than, for example, the first and second heated pressure roller systems **224**, **226**.

In one example, each heater system of the plurality of heater systems **208** can include mechanisms that can operate autonomously and independently of the other heater systems of the plurality of heater systems **208**. In one example, each heater system **208** can include a heating element, a temperature sensor, and a servomechanism or regulator that can operate via negative feedback. For example, the temperature sensor can detect a temperature of the heating element, and the servomechanism can compare the temperature to a selected setpoint or target temperature provided via the controller **214** to estimate an operational error. A servo process of the servomechanism can receive the operational error and determine a request for an amount of power from the controller **214** that can selectively heat the heating element in such a manner as to reduce the operational error. The heater system **208** can provide the requested amount of power as a load request to the controller **214**. The controller **214** can grant an amount of power based on the load request applied to a general power arbitration process as a power grant, and adjust the power grant to be an adjusted grant provided to the heater system **208**. In one example, pulse width modulation, or PWM, can be used to deliver power to the heating element, and the heater system **208** can provide the load request to the controller **214** and receive the adjusted grant from the controller **214** in terms of PWM. Additionally, the power output from the power source **216** can be provided to heater systems **208** and allocated in terms of PWM. While PWM is provided as an illustration in this disclosure, other power request and delivery techniques, including other signal modulation techniques, can be applied.

FIG. **3** illustrates an example power allocation engine **300**, which can be included as an aspect of the controller **214**, to implement the method **100** and distribute power from the power source **216** to the heater systems **208**. The power allocation engine **300** and heater systems **208** can be included as part of a conditioning system **310** of the printing device **200**. The example power allocation engine **300** includes a general power arbitration system **302** operably coupled to a contextual power adjustment system **304**. A plurality of independent load requests $L_1, L_2, \ldots, L_n$, from each of a plurality of printing device heater systems $H_1, H_2, \ldots, H_n$, **208** are received at the power allocation engine **300**, such as at the general power arbitration system **302**. The power source **216** can provide a power output S to the power allocation engine **300**. The general power arbitration system **302** can provide a general power arbitration process of the power output S to the plurality of independent load requests $L_1, L_2, \ldots, L_n$, and allocate a plurality of corresponding power grants $P_1, P_2, \ldots, P_n$ in response to the plurality of independent load requests $L_1, L_2, \ldots L_n$. The plurality of power grants $P_1, P_2, \ldots, P_n$ are provided to the context power adjustment system **304**. In one example, the context power adjustment system **304** adjusts the plurality of power grants $P_1, P_2, \ldots, P_n$ based on a contextual printing condition **306** to provide a plurality of adjusted grants $A_1, A_2, \ldots, A_n$ to the plurality of printing device heater systems

$H_1, H_2, \ldots, H_n$ **208**. The power allocation engine **300** can periodically sample the plurality of independent load requests $L_1, L_2, \ldots, L_n$, to allocate a plurality of corresponding power grants $P_1, P_2, \ldots, P_n$, and provide the plurality of adjusted grants $A_1, A_2, \ldots, A_n$ to the plurality of printing device heater systems $H_1, H_2, \ldots, H_n$ **208**. In one example, power allocation engine **300** can periodically sample the plurality of independent load requests $L_1, L_2, \ldots, L_n$, and provide the plurality of adjusted grants $A_1, A_2, \ldots, A_n$ to the plurality of printing device heater systems $H_1, H_2, \ldots, H_n$ **208** every few seconds, such as every three seconds.

The general power arbitration system **302** provides a general power arbitration of the power output S from the power source **216**. In one example, the general power arbitration system **302** ensures that a sum total of the plurality of power grants $P_1, P_2, \ldots, P_n$ does not exceed the power output S from the power source **216**. The general power arbitration system **302** can determine a normalizing factor N from the plurality of load requests $L_1, L_2, \ldots, L_n$. In order to generate the normalizing factor N, the plurality of load requests $L_1, L_2, \ldots, L_n$ are added together and the resulting sum L_{TOT} is divided by the power output S to determine a quotient Q, i.e., $Q=L_{TOT}/S$. The normalizing factor N is the larger of the quotient Q or 1, i.e., $N=\max(Q, 1)$, in which $\max(Q, 1)$ returns the larger value of Q and 1. In one simple example of a general power arbitration system **302**, each load request L_i is divided by the normalizing factor N to obtain a corresponding power grant P_i, i.e. $P_i=L_i/N$.

The general power arbitration system **302** may allocate the plurality of the power grants $P_1, P_2, \ldots, P_n$ according to fixed weights $w_1, w_2, \ldots, w_n$ assigned to the heater systems $H_1, H_2, \ldots, H_n$ **208** based on the received plurality of independent load requests $L_1, L_2, \ldots, L_n$. For example, the general power arbitration system **302** may determine each power grant P_i from the corresponding load request L_i according to $P_i=(w_iL_i)/N$. In one example of a determining a normalizing factor N using fixed weights to allocate power arbitration, a weighted normalizing factor N_w can be calculated so that the sum of the power grants $(P_1+\ldots+P_n)$ does not exceed the power output S. In this example, a weight quotient Q_w is determined as $Q_w=(w_1L_1+\ldots+w_nL_n)/S$, and the weighted normalizing factor N_w is provided from $N_w=\max(Q_w, 1)$. Each power grant Pi can be determined via $P_i=(w_iL_i)/N_w$.

In this example, the weights $w_1, w_2, \ldots, w_n$ may be assigned to the plurality of heater systems $H_1, H_2, \ldots, H_n$ **208** in such a manner as to give a load request from a heater system of the plurality of heater systems preference over a load request from another heater system of the plurality of heater systems $H_1, H_2, \ldots, H_n$ **208**, such as if a weight w_i was larger than another weight. A relatively larger weight w_i would give relatively more priority to the corresponding load request L_i, and a relatively smaller weight w_i would give relatively less priority to the corresponding load request L_i. Also, the weights $w_1, w_2, \ldots, w_n$ may be assigned to plurality of heater systems in such a manner as to not give preference to the load request of a heater system over the load request of another heater system, such as if the weights $w_1, w_2, \ldots, w_n$ were equal to each other, including all of the weights set to 1. In some example, the weights can be stored as data in a non-transitory storage medium, selectively modified on occasion, and applied to the general power arbitration system **302** to determine the power grants $P_1, P_2, \ldots, P_n$.

In another example, the general power arbitration system **302** may allocate the plurality of the power grants $P_1, P_2, \ldots, P_n$ according to a fixed priority order assigned to the heater systems $H_1, H_2, \ldots, H_n$ **208** based on the received plurality of independent load requests $L_1, L_2, \ldots, L_n$. In this example, the general power arbitration system **302** provides a power grant P_i to a load request L_i from a heater system H_i having a higher assigned priority before it will provide a power grant to a load request from a heater system having a lower assigned priority. In one example, the heater system having the highest priority will receive a power grant based on a corresponding load request. If any power output from the power source **216** remains to be allocated, the heater system having the next highest priority will receive a power grant based on a corresponding load request, and so on, until all heater systems have received a power grant or the power output S has been completely allocated.

In one example, the general power arbitration system **302** applies priority, whether by assigning weights $w_1, w_2, \ldots, w_n$ or by assigning a priority order, via thermal time constant of the corresponding heater system **208**. For example, the heater system having the largest thermal time constant is ascribed the highest priority, the heater system with the next largest thermal time constant is ascribed the next highest priority, and so on until the heater system with the smallest thermal time constant is ascribed the lowest priority. In the example of the heater systems **208**, the evaporative dryer **222** generally includes a larger, or longer, thermal time constant than the first and second heated pressure roller systems **224**, **226**, and thus can be ascribed a higher priority in the general power arbitration system **302**.

If the power allocation engine **300** does not receive a contextual printing condition **306**, the power allocation engine can simply provide the power grants $P_1, P_2, \ldots, P_n$ to the corresponding heater systems $H_1, H_2, \ldots, H_n$ **208**. The context power adjustment system **304** can be bypassed or not invoked. The power output S is allocated to the heater systems heater systems $H_1, H_2, \ldots, H_n$ **208** according to the power grants $P_1, P_2, \ldots, P_n$. If, however, the power allocation engine **300** receives a contextual printing condition **306**, the context power adjustment system **304** is invoked.

The context power adjustment system **304** adjusts each power grant P_i from general power arbitration system **302** based on the contextual printing condition **306** received at the power allocation engine **300**. The contextual printing condition **306** can be based on various conditioning characteristics or characteristics of the printing device **200** that may affect printing under general power arbitration system **302**. For example, the contextual printing condition **306** can include data related to the medium to be printed such as the type of medium and the orientation of the medium during printing, data related to the print substance **206** such as the type and the amount of print substance to be applied to the medium, data related to ambient settings, and data related to the printing device **200** such as whether the printing device **200** is in sleep mode or at startup, whether a heater system **208** is working inefficiently based on system diagnostics, and other characteristics. The context power adjustment system **304** receives the contextual printing condition **306** and applies a set of rules that can be included in a plurality of sets of rules, to adjust the power grants P_i from the general power arbitration system **302** to address the contextual printing condition **306**. According to the contextual printing condition **306**, the power grant P_i is adjusted with the context adjustment system **304** to generate an adjusted grant A_i, and the adjusted grant A_i is provided to the corresponding heater system H_i.

In one example contextual printing condition **306**, the context power adjustment system **304** is configured such that the adjusted grant A_i is selected from one of the power grant P_i and a power grant limit Cap_i if the power grant P_i exceeds the power grant limit Cap_i. The contextual printing condition **306** can include circumstances in which the heater systems **208** may be at ambient temperature and may each provide relatively high load requests L_i to the power allocation engine **300**. The contextual printing condition **306** can be invoked in circumstances such as printing device startup and awakening from a sleep or standby mode. Temperature sensors in the heater systems **208** as well as load requests L_i and the status of the printing device **200** can be used to determine the contextual printing condition **306**. The power allocation engine **300** can distribute power to the heater systems **208** and can maintain priority of the general arbitration system **302** but not permit a heater system to starve another heater system of power under general power arbitration.

In the example of the printing device **200**, the context power adjustment system **304** can receive the power grants P_i and provide an adjusted grant according to

$A_1=\min(P_1, Cap_1)$, in which H_1 is the dryer system **222**;

$A_2=\min(P_2, Cap_2)$, in which H_2 is the first heated pressure roller system **224**;

$A_3=\min(P_3, Cap_3)$, in which H_3 is the second heated pressure roller system **226**; and

the sum of $Cap_1+Cap_2+Cap_3$ does not exceed S.

The power grant limit Cap_i for each heater system **222**, **224**, **226** can be determined based on a factors such as relative load requests from each heater system **222**, **224**, **226** or based on providing the fastest warm-up time of the heater systems **208**. In one example, the sum of $Cap_1+Cap_2+Cap_3$ is equal to S. The context power adjustment system **304** implementing method **100** can provide for faster or more efficient warm-up times of the heater systems **208** than with general power arbitration.

In another example contextual printing condition **306**, the context power adjustment system **304** is configured to provide an adjusted grant A_i to a printing device heater system of the plurality of printing device heater systems **208** if a selected orientation of the medium is invoked. In this example, the general power arbitration system **302** can be configured to provide power outputs P_i based on a more common orientation of the printed medium through the media path **212**, such as a longer edge of the printed medium being fed through the media path **212** as the leading edge. The more common orientation may subject the medium to the inner heated pressure roller system **224** as well as the outer heated pressure roller system **226** (and the dryer system **222**). The medium may not be subjected to much heat from the outer heated pressure roller system **226** in the selected orientation. The selected media orientation can be used to determine the contextual printing condition **306** and ambient settings can be received. In such an contextual printing condition **306**, the power grant P_2 to the outer heated pressure roller system H_2 **226** may be reduced by a medium orientation compensation factor F, in which F is equal to or greater than 0 and less than 1. The reduced power from the outer heated pressure roller system H_2 **226** may be apportioned to the inner heated pressure roller system H_1 **224** or to the dryer system H_3 **222**.

In the example of the printing device **200**, the context power adjustment system **304** can receive the power grants P_i from the general power arbitration system **302** and provide an adjusted grant A_i based on a factor F, which is greater than 0 but less than or equal to 1, according to:

$A_1=P_1+(P_2-P_2*F)/2$, in which H_1 is the inner heated pressure roller system **224**;

$A_2=P_2*F$, in which H_2 is the outer heated pressure roller system **226**;

$A_3=P_3+(P_2-P_2*F)/2$, in which H_3 is the dryer system **222**.

In another example of the printing device **200**, the context power adjustment system **304** can receive the power grants P_i from the general power arbitration system **302** and provide an adjusted grant A_i based on an offset amount M according to:

$A_1=P_1+M/2$, in which H_1 is the inner heated pressure roller system **224**;

$A_2=P_2-M$, in which H_2 is the outer heated pressure roller system **226**;

$A_3=P_3+M/2$, in which H_3 is the dryer system **222**.

In one example, the medium orientation compensation factor F or offset amount M can be determined via characterization of the printing device **200** to provide an appropriate contextual compensation. Further, the medium orientation compensation factor F or offset amount M may be adjusted based on ambient settings such as ambient temperature or humidity.

In other examples, the contextual printing condition **306** can be based on print substance density and, in some examples, also on a load request. Print substance density can correspond with an amount of print substance **206** to be applied to a unit of media, such as a sheet of paper or a page, for a given printing project or printed medium. In some examples, duplex, or double sided printing, can be considered in determining print substance density. A given medium with relatively large amount of print substance generally includes a higher print substance density than the given medium with a relatively less amount of print substance. In some examples, the type of print substance or print substance formulation can also affect print substance density, such as print substance that include a larger percentage of water per unit of print substance may provide a larger print substance density per unit of print substance applied to the medium than print substances with a smaller percentage of water per unit of print substance applied to the medium. In one example, a printed medium is first conditioned with the evaporative dryer **222** along the media path **212**. Media jams, such as paper jams, may occur along the media path **212** prior to the first and second heated pressure roller systems **224**, **226** if the printed medium is poorly conditioned with the dryer **222**. Print substance density can affect the conditioning of the printed medium. In general, a given medium with a larger print substance density is more difficult to condition with the dryer system than the medium with a smaller print substance density. For example, in order to avoid such jams or other deleterious effects, the printed medium is not conditioned with the dryer system **222** until the dryer system **222** has reached a suitable temperature for media with relatively high print substance density. A contextual printing condition **306** can include a relatively high print substance density that may be accompanied with a relatively large load request from the dryer **222**, such as if the printing device **200** has been idle or the temperature of the dryer system **222** is low. Conversely, a contextual printing condition **306** can include a relatively low print substance density that may be accompanied with a relatively small load request from the dryer system **222** such as if the dryer system **222** is already warm.

FIG. **4** illustrates a graph **400** of a plurality of contextual printing conditions that can be applied to **306** based on print substance density and, in some examples, also on a load request. Based on factors such as the amount of print substance on a given medium, as well as factors that may include the type of print substance applied to the medium such as the amount of moisture in the print substance, and the type of medium, the page to be printed, or the print job, can be provided with a print substance density score D. The graph **400** includes a horizontal axis **402** having values of the print density from a zero print substance density to a maximum print substance density (such as print substance density of a medium completely saturated with print substance). The graph **400** also includes a vertical axis **404** having values of a load request L_i from a zero load request to a maximum load request (such as a load request that is equal to the power output S). In one example, the load request L_i of the vertical axis **404** can correspond with the heater system H_i having the largest thermal time constant, such as the dryer systems **222** of the heater systems **208**, which may also be positioned first along the media path **212** to condition the medium prior to the first and second heated pressure roller systems **224**, **226**.

Graph **400** illustrates circumstances for three contextual printing conditions. A contextual printing condition **406** can be invoked in a circumstance having a relatively high load request L_i and a relatively high print substance density score D. In this example, the load request L_i is greater than a selected load request value Y2 and the print substance density score D is greater than a selected print substance density value X2. Another contextual printing condition **408** can be invoked in a circumstance having a relatively low load request L_i and a relatively low print substance density score D. In this example, the load request L_i is less than a selected load request value Y1 and the print substance density score D is less than a selected print substance density value X1. Still another contextual printing condition **410** can be invoked in a circumstance having a relatively very high print substance density score D regardless of the load request L_i. In this example, the print substance density score D is greater than a selected print substance density value X3. Other contextual printing conditions on graph **400** are contemplated. In some examples, contextual printing conditions on graph **400**, including contextual printing conditions **406**, **408**, **410**, may overlap. For example, illustrated contextual printing conditions **408** and **410** overlap in cases in which the load request L_i is greater than value Y2 and the print substance density score D is greater than value X3. In one example, print substance density values X3>X2>X1, and load request values Y2>Y1.

In one example, the context power adjustment system **304** is configured to provide adjusted grants A_i to the plurality of printing device heater systems **208** if contextual printing condition **406** is invoked. In this example, all or substantially all of the power output S is allocated to the printing device heater system H_i of the plurality of printing device heater systems having the largest thermal time constant, such as the dryer system **222**, if the print substance density score D meets or exceeds a selected print substance density threshold, such as the print substance density score D meets or exceeds print substance density value X2, and the load request L_i of the plurality of independent load requests meets or exceeds a selected load threshold, such as the load request equals or exceeds load request value Y2.

In the example of the printing device **200**, the context power adjustment system **304** can provide adjusted grants according to:

If the print substance density score D is equal to or greater than print substance density value X2 and the load request L_1 is equal to or greater than load request value Y2, then

A_1=S, in which H_1 is the dryer system **222**;

A_2=0, in which H_2 is the first heated pressure roller system **224**;

A_3=0, in which H_3 is the second heated pressure roller system **226**.

The adjusted grants can provide for a relatively quick time to prepare the conditioning system **310** including the heater systems **208** of the printing device **200** to receive a printed medium. The adjusted grants in contextual printing condition **406** provide faster preparation of the conditioning system **310** than with the general power arbitration system **302** alone. In some examples, the contextual printing condition **406** can cause the power allocation engine **300** to bypass the general power arbitration system **302** because, in such examples, the power grants $P_1, P_2, \ldots, P_n$, are not relevant in determining the adjusted grants or to the allocation of the power output S. The contextual printing condition **406** can be invoked in an example circumstance such as in printing documents with heavy text or heavy graphics in which the dryer system **222** is at ambient temperature such as when the printing device **200** has been idle for a relatively long period of time, such as enough time to cause the printing device **200** to enter a sleep mode. The values of X2 and Y2 can be determined by characterization. Further, the values of X2 and Y2 may be adjusted based on ambient settings such as ambient temperature or humidity.

In one example, the context power adjustment system **304** is configured to provide adjusted grants A_i to the plurality of printing device heater systems **208** if contextual printing condition **408** is invoked. The adjusted grants A_1, A_2, A_3, from the power source to the plurality of heater systems H_1, H_2, H_3, **208** includes a measure of the power grant P_1 to the dryer system **222** apportioned to the power grants P_2, P_3 to the first and second heated pressure roller systems **224**, **226** rather than the measure provided to the power grant P_1 to the dryer system **222** if a print substance density score D is within a selected print substance density threshold, such as the print substance density score D meets or is less than print substance density value X1, and the load request L_1 from the dryer system is within a selected load request threshold, such as the load request L_1 meets or is less than load request value Y1.

In the example of the printing device **200**, the context power adjustment system **304** can provide adjusted grants according to:

If the print density score D is equal to or less than print substance density value X1 and the load request L_1 is equal to or less than load request value Y1, then

A_1=0, in which H_1 is the dryer system **222**;

$A_2=P_2+j*P_1$, in which j is greater than 0 and less than or equal to 1 and in which H_2 is the first heated pressure roller system **224**;

$A_3=P_2+k*P_1$, in which k is equal to 1−j and in which H_3 is the second heated pressure roller system **226**.

The adjusted grants can provide for a relatively quick time to prepare the conditioning system **310** including the heater systems **208** of the printing device **200** to receive a printed medium. The contextual printing condition **408** provides faster preparation of the conditioning system than with the general power arbitration system **302** alone. In such a situation, the printing device **200** can begin printing with a relatively low temperature of the dryer system **222** or without having to allocate much or any of the power output S to the dryer system **222**. Instead, the first and second heated pressure roller systems **224**, **226** are given priority in the power allocation because such heater systems have primacy in circumstances of print outputs of low print substance density and when the dryer system **222**, or a heater system H_1 with the higher thermal time constant, provides a relatively small load request L_1. The contextual printing condition **408** can be invoked in an example circumstance of printing documents with light text or light graphics in which the dryer is already warm or the dryer may not be used to condition the medium. The values of X1 and Y1 may be adjusted based on ambient settings such as ambient temperature or humidity, and the values of j and k may be equal to each other such as 0.5.

In one example, the context power adjustment system **304** is configured to provide adjusted grants A_i to the plurality of printing device heater systems **208** if contextual printing condition **410** is invoked. The adjusted grants A_1, A_2, A_3, from the power source to the plurality of heater systems H_1, H_2, H_3, **208** includes a measure of the power grants P_2 and P_3 to the first and second head pressure roller systems **224**, **226** apportioned to the power grant P_1 to the dryer system **222** rather than the measure provided to the power grant power grants P_2 and P_3 to the first and second head pressure roller systems **224**, **226** if the print substance density score D is outside a selected print substance density threshold, such as the print substance density score D meets or exceeds print substance density value X3. The measure of the power grants P_2 and P_3 can be based on an evaporative cooling offset amount E.

In the example of the printing device **200**, the context power adjustment system **304** can provide adjusted grants according to:

If the print density score D is equal to or greater than print substance density value X3, then

$A_1=P_1+E$, in which H_1 is the dryer system **222**;

$A_2=P_2-E/2$, in which H_2 is the first heated pressure roller system **224**;

$A_3=P_3-E/2$, in which H_3 is the second heated pressure roller system **226**.

In another example using an evaporative cooling factor c, which is greater than 1, rather than the evaporative cooling offset amount E, if the print density score D is equal to or greater than print substance density value X3, then

$A_1=cP_1$, in which H_1 is the dryer system **222**;

$A_2=P_2-(cP_1-P_1)/2$, in which H_2 is the first heated pressure roller system **224**;

$A_3=P_3-(cP_1-P_1)/2$, in which H_3 is the second heated pressure roller system **226**.

The adjusted grants can provide for compensation to the dryer system **222**, or other heater system with a relatively high thermal time constant, that may be cooled by the sheer amount of print substance on the medium, particularly if the print substance is a water-based print substance. The contextual printing condition **410** provides extra power than requested to provide for increased thermal control that may reduce media jams and improve media attributes. The print substance density value X3 may be adjusted based on ambient settings such as ambient temperature or humidity. The evaporative cooling offset amount E, the evaporative cooling factor c, and print substance density value X3 can be determined by characterization of the printing device **200**.

FIG. **5** illustrates an example system **500** including a processor **502** and memory **504** and program **506** to implement example method **100**. In one example, system **500** can be implemented with the controller **214** of the printing device **200** as the power allocation engine **300**. Program **506** can be implemented as a set of processor-executable instructions stored on a non-transitory computer readable medium such as memory **504** to control processor **502**. Computer readable media, computer storage media, or memory may be implemented to include a volatile computer storage media, nonvolatile computer storage media, or as any suitable method or technology for storage of information such as computer readable or executable instructions, data structures, program modules or other data. A propagating signal by itself does not qualify as storage media or a memory device.

System **500** is configured to receive a plurality of load requests $L_1, L_2, \ldots, L_n$ as signal data from heater systems **208**. In one example, each of the load requests is received as a PWM signal that may be converted to digital data for use with program **506**. System **500** may also receive a contextual printing condition **306** as a set of data stored in on a computer storage medium or provided via signals received from components of a printing device **200** and a power output S from a power source **216** to be allocated to the heater systems **208**. System **500** applies contextual printing condition **306** to generate power grants $P_1, P_2, \ldots, P_n$ or adjusted grants $A_1, A_2, \ldots, A_n$ corresponding with the load requests provided to the heater systems **208** via signals such as PWM signals.

Although specific examples have been illustrated and described herein, a variety of alternate and/or equivalent implementations may be substituted for the specific examples shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific examples discussed herein. Therefore, it is intended that this disclosure be limited only by the claims and the equivalents thereof.

The invention claimed is:

1. A method, comprising:

periodicially receiving a plurality of independent load requests from each of a plurality of printing device heater systems;

allocating a plurality of power grants based on a general power arbitration of a power source in response to the plurality of independent load requests, the plurality of power grants applied to the to the plurality of printing device heater systems if a contextual printing condition is not selected; and

adjusting a power grant of the plurality of power grants based on the selected contextual printing condition to provide an adjusted grant from the power source to a printing device heater system of the plurality of printing device heater systems.

2. The method of claim **1** wherein the receiving the plurality of independent load requests include receiving a pulse width modulation signal from each of the printing device heater systems.

3. The method of claim **1** wherein the adjusted power grant is provided to the printing device heater system of the plurality of printing device heater systems as a pulse width modulation signal.

4. The method of claim **1** wherein the adjusting the power grant includes adjusting the plurality of power grants based on the contextual printing condition to provide a plurality of adjusted power grants to the plurality of printing device heater systems.

5. The method of claim **1** wherein the general power arbitration of the power source includes using one of fixed weights and a fixed priority order.

6. The method of claim 1 wherein the contextual printing condition is based on one of a medium orientation and a print substance density.

7. The method of claim 6 wherein the adjusting the power grant for the contextual printing condition based on a print substance density includes determining the adjusted grant from a thermal time constant of the printing device heater system of the plurality of heater systems and whether the print substance density is outside a selected threshold amount.

8. The method of claim 1 wherein the contextual printing condition is determined from ambient settings.

9. A printing device, comprising:

a conditioning system having a plurality of heater systems, each of the plurality of heater systems to provide an independent load request;

a power source operably coupled to the conditioning system, the power source to provide a power output to the plurality of heater systems; and

a controller operably coupled to the plurality of heater systems and the power source to distribute the power output between the plurality of heater systems, the controller to

receive the independent load requests,

allocate a plurality of power grants based on a general power arbitration of the power output applied to the independent load requests, and

adjust a power grant of the plurality of power grants based on a contextual printing condition as a contextual printing rule applied to the plurality of power grants to provide an adjusted grant to a heater system of the plurality of heater systems.

10. The printing device of claim 9 wherein the plurality of heater systems include a servomechanism.

11. The printing device of claim 9 wherein the heater systems include a dryer system and a heated pressure roller system.

12. The printing device of claim 9 wherein each of the plurality of heater systems provides the independent load requests as a pulse width modulation load request signal and the controller provides the adjusted grant to the heater system of the plurality of heater systems as a pulse width modulation adjusted grant signal.

13. A non-transitory computer readable medium to store computer executable instructions to control a processor to:

receive a plurality of independent load requests from each of a plurality of printing device heater systems;

allocate a plurality of power grants based on a general power arbitration of a power source applied to the plurality of independent load requests; and

adjust a power grant of the plurality of power grants based on a contextual printing condition as a contextual printing rule applied to the plurality of power grants to provide an adjusted grant from the power source to a printing device heater system of the plurality of printing device heater systems.

14. The non-transitory computer readable medium of claim 13 wherein the general power arbitration includes executable instructions to apply one of a fixed weights and a fixed priority order.

15. The non-transitory computer readable medium of claim 13 including executable instructions to adjust the power grant based on one of a print substance density and a medium orientation.

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